Abstract

Network control (or network management) functions are essential for efficient and reliable operation of a network. Some control functions are currently included as part of the OSI (Open Systems Interconnection) model. For local area networks it is widely recognized that there is a need for additional control functions, including fault isolation functions, monitoring functions, and configuration functions. These functions can be implemented in either a central or a distributed manner. The FDDI (Fiber Distributed Data Interface) Medium Access Control and Station Management protocols provide an example of a distributed implementation.

Network Reliability

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Outline

- Meaning of network reliability
- Current approach to problem
- Additional issues to address
- Implementation alternatives
- Issues for study

State of local area network technology

- Past –
  Mechanics of communication emphasized

- Present –
  Need for network control recognized

- Space Station –
  Requires high degree of reliability

Meaning of Reliability

- Wide area networks –

  Degree of connectivity, i.e., availability of alternate routing

- Local area networks –

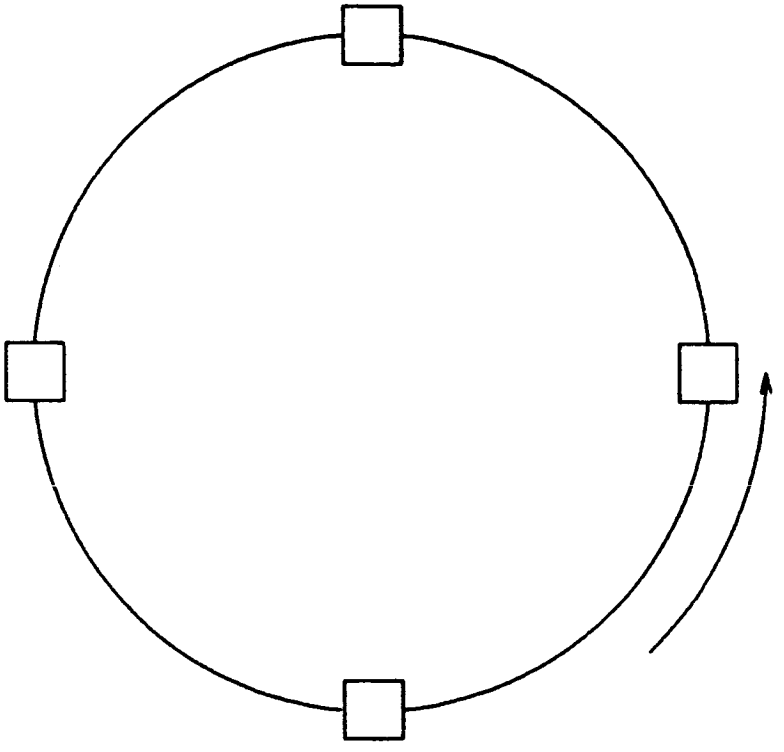
  Ensuring that a single error will not cause failure of the entire network

  Providing for recovery from errors without significant degradation of performance

General Reliability Concerns for LANs

- Cable vulnerability
- Jabbering transmitter
- Failure isolation
- Bit synchronization
- Protocol–related problems

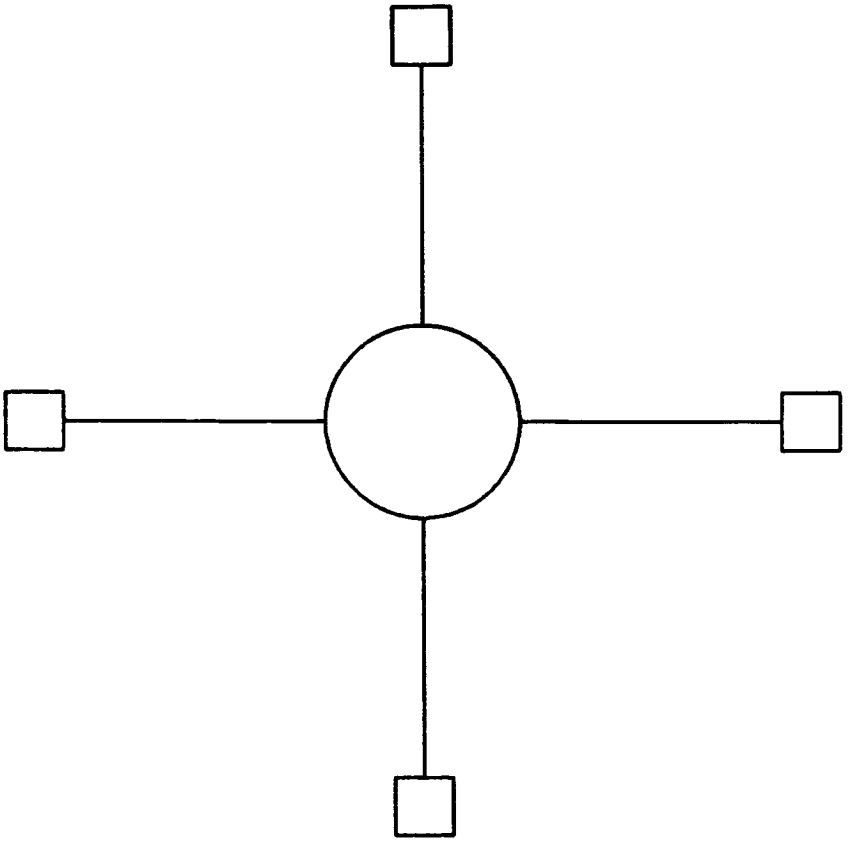
Token Ring



Reliability concerns

- Break in physical path
- Token–related problems
  - Lost token
  - Duplicate tokens
  - Token recovery

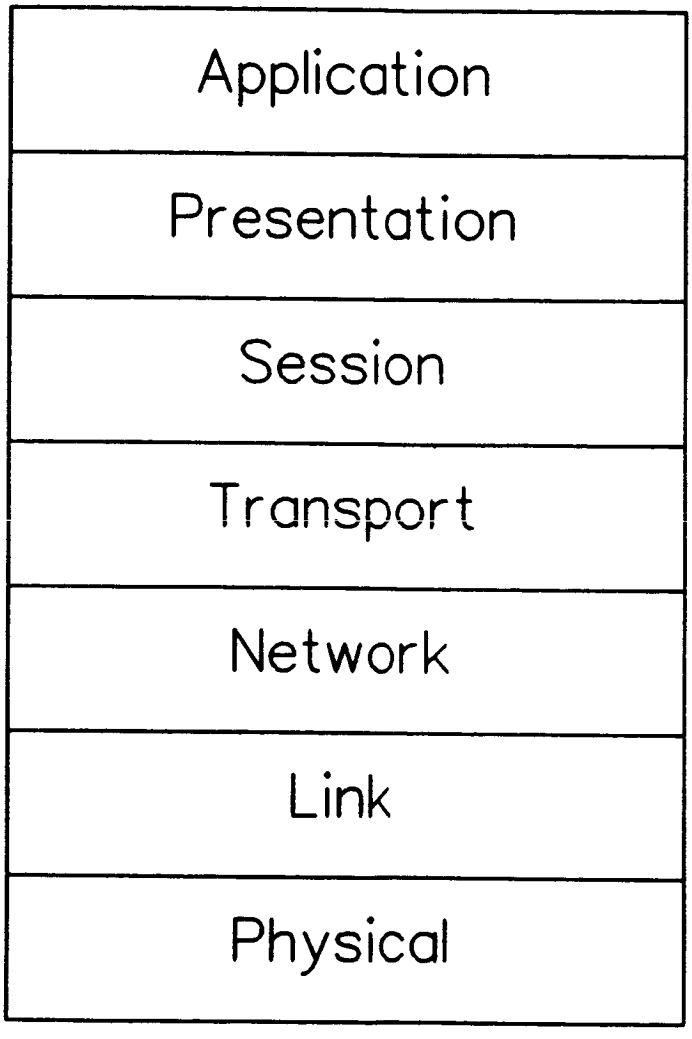
Star Topology



Reliability concerns

- Vulnerability of star node
- Complexity of star node
- Coordinating time–slots
- Station insertion or removal

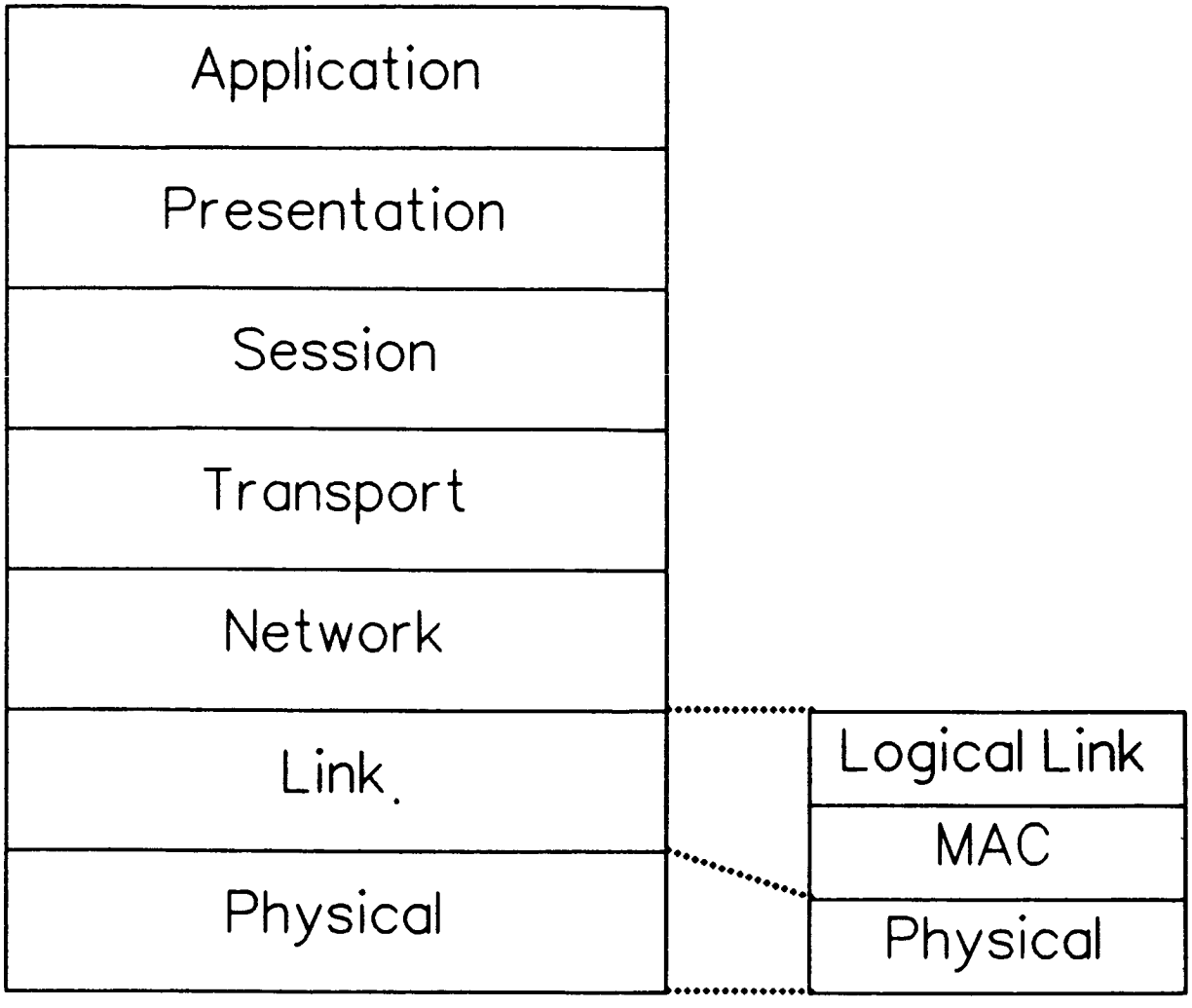
Layers of OSI Model



OSI Control Functions

- Link Layer
  - Flow control
  - Error control
  - Acknowledgement
- Network Layer
  - Virtual circuit service
  - Datagram service
  - Congestion control
- Transport Layer
  - Buffer control
  - Connection management
  - End–to–end error recovery and flow control
- Application Layer
  - Network management

Layers of OSI Model for Local Area Networks



Local Area Network Control

- Fault isolation
  - Monitor network to detect faults
  - Isolate fault to single component
  - Fault correction
- Monitoring functions
  - Performance measurement
  - Performance analysis
  - Artificial traffic generation
- Configuration functions
  - Directory management
  - Set station parameters
  - Station insertion and removal
  - Station reset

Statistics to gather

- number of packets
- number of packets by source
- number of packets by destination
- number of data packets
- number of control packets
- packet size
- packet delay
- number of retransmissions
- number of collisions
- number of packets received in error

Data analysis

- Distribution of traffic
- Excessive collisions?
- Excessive retransmissions?
- Excessive packet delay?
- Success of station in transmitting packets
- Maximum capacity of channel
- Effect of traffic load on performance

Artificial traffic generation

- Test network in laboratory
- Indicate existence of potential problems
- Indicate efficiency of system
- Plan for future growth

Implementation alternatives

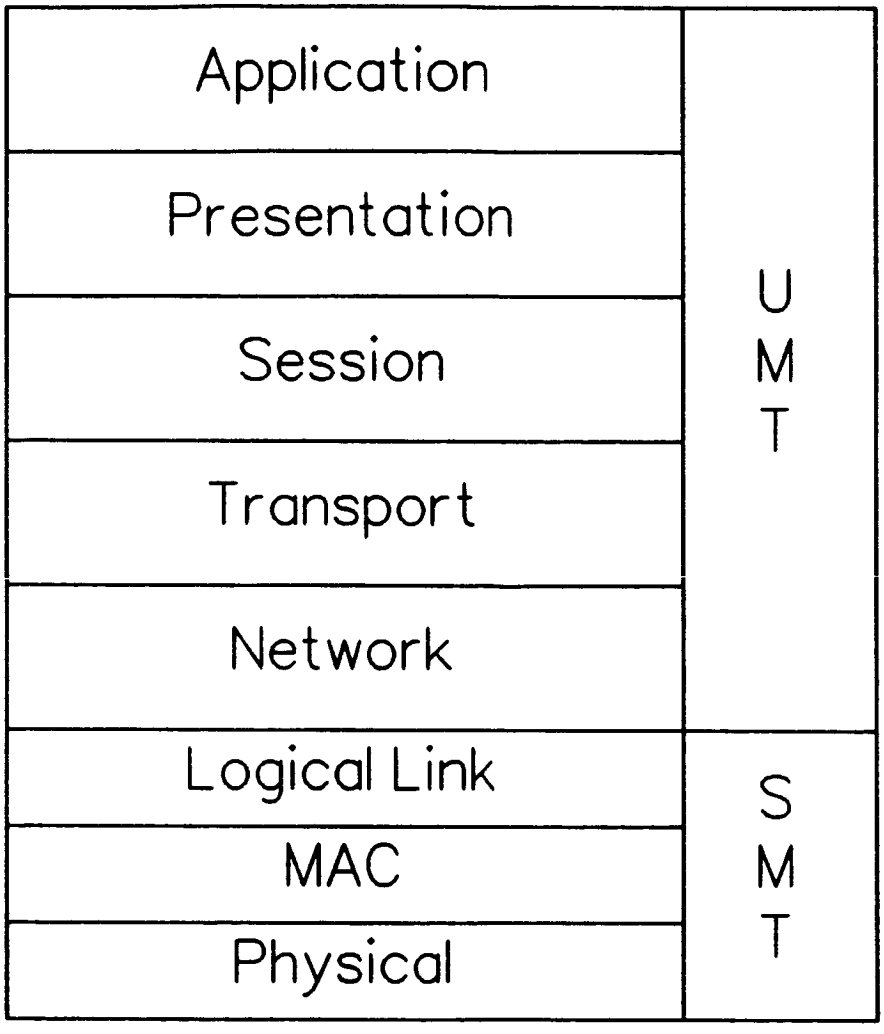
Central

- Network Control Center
- NBS "measurement center"

Distributed

- Separate network control layer
- Implementing control functions in each layer

FDDI Network Control



SMT = Station Management
UMT = Upper Management

FDDI Implementation of control functions

- Fault isolation functions
  - Timers
  - Claim token recovery process
  - Beacon frame
- Configuration functions
  - Optical station bypass
  - Redundant channel
  - Station Management functions
    - Station reset
    - Insertion of station
    - Timer alignment

- Monitoring functions
  - Status bits
  - Station flags
    - Error detected
    - Address recognized
    - Frame copied
  - Station counters
    - Frames received
    - Timer expirations
  - Interface to Station Management

Open Issues

- Identify proper control functions to assign to upper layers of the OSI model
- Determine effect on network performance and network reliability of
  - Buffer management
  - Acknowledgement schemes
  - Retransmission schemes
  - Multi–layer protocol structure
- Determine how to automate control functions